इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

IS 12516-3 (1988): Method for determination of physical characteristics of doughs made from wheat flour, Part 3: Water absorption and rheological properties using a valorigraph [FAD 16: Foodgrains, Starches and Ready to Eat Foods]

"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

"पुष्टित १९९४"
"RE-AFFIRMED 1994"

IS : 12516 (Part 3) - 1988
(Reaffirmed 2005)

Indian Standard

METHOD FOR DETERMINATION OF PHYSICAL CHARACTERISTICS OF DOUGHS MADE FROM WHEAT FLOUR

PART 3 WATER ABSORPTION AND RHEOLOGICAL PROPERTIES USING A VALORIGRAPH

UDC 664·653·8·016·8

© *Copyright* 1989

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 3 *April* 1989

Indian Standard

METHOD FOR DETERMINATION OF PHYSICAL CHARACTERISTICS OF DOUGHS MADE FROM WHEAT FLOUR

PART 3 WATER ABSORPTION AND RHEOLOGICAL PROPERTIES USING A VALORIGRAPH

0. FOREWORD

0.1 This Indian Standard (Part 3) was adopted by the Bureau of Indian Standards on 28 October 1988, after the draft finalized by the Foodgrains and Foodgrain Industry Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 This standard is being published in the following four parts:

Part 1 Water absorption and rheological properties using a farinograph

Part 2 Rheological properties using an extensograph

Part 3 Water absorption and rheological properties using a valorigraph

Part 4 Rheological properties using an alveograph

0.3 In the preparation of this standard, guidance has been taken from ISO/DIS 5530-3 'Wheat flour—Physical characteristics of doughs—Part 3: Determination of water absorption and rheological properties using a valorigraph', issued by the International Organization for Standardization (ISO).

0.4 In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 3) specifies a method, using a valorigraph for determination of water absorption of flours and the mixing behaviour of doughs made from them.

1.2 This method is applicable to flour or meal from wheat (*Triticum aestivum* Linnaeus).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Consistency — The resistance, expressed in arbitrary units (valorigraph units, VU) of a dough to being mixed in the valorigraph, at a specified, constant speed.

2.2 Water Absorption (of flour) — The volume of water, expressed in millilitres per 100 g of flour at 14 percent (*m/m*) moisture content, required to produce a dough with a maximum consistency of 500 VU, under the operating conditions specified in this standard.

3. PRINCIPLE

3.1 Measurement and recording, by means of a valorigraph, of the consistency of a dough as it is formed from flour and water, as it is developed, and as it is broken down.

NOTE — The maximum consistency of dough is adjusted to a fixed value by adapting the quality of water added. The correct water addittion, which is called the water absorption, is used to obtain a complete mixing curve, the various features of which are a guide to the strength of the flour.

4. REAGENT

4.1 Distilled Water — shall be used where the use of water as a reagent is intended (*see* IS : 1070-1977*).

5. APPARATUS

5.1 Valorigraph — *See* Appendix A.

5.1.1 *Operating Characteristics*

a) Slow blade rotational frequency: 64 ± 2 min^{-1}.

The ratio of rotational frequencies of the mixing blades shall be 1·50 ± 0·01.

b) Deflection of the recorder pen when the lever arm is loaded, at the appropriate position (75 mm from the pivot), with the calibrating weight (900 g, accessory of the instrument), with the mixing blades rotating in the empty bowl: 500 ± 10 VU.

c) Chart speed: 1·00 ± 0·03 cm/min.

---

*Specification for water for general laboratory use (*second revision*).

5.1.2 *Burette*

a) Burette calibrated from 25 to 35 ml, accurate to nearest 0·1 ml, and

b) Burette calibrated from 32 to 42 ml, accurate to nearest 0·1 ml.

The time to flow from 0 to 35 or 42 ml, respectively shall be not more than 20 s.

5.2 Balance — accurate to 0·1 g.

5.3 Soft Plastic Spatula

6. SAMPLING

6.1 Sampling shall be carried out by the method specified in IS : 5315-1978*.

7. PROCEDURE

7.1 Moisture Content of Flour — Determine the moisture content of the flour by the method specified in IS : 4333 (Part 2)-1967†.

7.2 Preparation of Sample and Apparatus

7.2.1 If necessary, bring the flour to a temperature of 25 ± 5°C. Fill the flask of valorigraph with water (**4.1**). Switch on preheating and thermostatically controlled heating. When the air temperature has reached 28°C, switch off the preheating. Start a flow of tap water through the cooling tubes of the valorigraph. Before and during use, check the temperatures of the air in the central part of the cabinet. The air temperature shall be between 28 and 30°C, with the mixer mounted, for at least 10 min before the first test portion is placed into the mixer. During use, the air temperature shall be 30 ± 0·2°C.

7.2.2 Adjust the arm of the recorder pen so as to obtain zero deflection with the mixing blades rotating in the empty, clean bowl. Adjust the damper so that with the motor running, the time required for the pointer to go from 1 000 to 100 VU is 1·0 ± 0·2 s.

7.2.3 Fill the burette with water. Fill the tip of the burette by letting about 1 ml of water flow into a vessel; fill the burette again.

7.3 Test Portion

7.3.1 Weigh, to the nearest 0·1 g, the equivalent of 5 g of flour having a moisture content of 14 percent. Let this mass, in grams, be m (*see* Table 1 for m as a function of moisture content).

7.3.2 Switch off the heating. Place the flour into the mixer. Cover the mixer and keep it covered until the end of mixing (**7.4.1**), except for the shortest possible time when water has to be added, and the dough scraped down (*see* **A-2.2**). Switch on the thermostatically controlled heating.

7.4 Determination

7.4.1 Mix for 1 min or slightly longer. Start adding water from the burette into the mixer when a whole-minute ordinate line on the recorder passes by the pen.

NOTE — In order to reduce waiting time, the recorder paper may be moved forward during the mixing of the flour. Do not move it backward.

7.4.1.1 Add a volume of water close to that expected to produce a maximum consistency (**8.1**) of 500 VU. When the dough forms, scrape down the sides of the bowl with the spatula (**5.3**), adding any adhering particles to the dough, without stopping the mixer. If the consistency is too high, add a little more water to obtain a maximum consistency (**8.1**) of approximately 500 VU. Stop mixing and clean the mixer.

7.4.2 After cleaning, place the parts of the mixer for at least 2 min in the water bath (**5.4**) at a temperature of 31 ± 1°C. Dry and mount them rapidly. Wait for at least 5 min with temperature control operating before the next mixing.

7.4.3 Make further mixings as necessary, until two mixings are available:

a) in which the water addition has been completed within 25 s,

b) the maximum consistencies (**8.1**) of which are between 480 and 520 VU, and

c) the recording of which has been continued for at least 12 min after the end of the development time (**8.2**) if the degree of softening is to be reported.

Stop mixing and clean the mixer. Between successive mixings, repeat **7.4.2**.

8. EXPRESSION OF RESULTS

8.1 Water Absorption — From each of the mixings with maximum consistencies between 480 and 520 VU, derive the corrected volume V_c, in millilitres, of water corresponding to a maximum consistency of 500 VU, by means of the following formulae:

$$V_c = V + 0{\cdot}016\,(C - 500)$$

where

V = volume, in millilitres, of water added; and

C = maximum consistency, in valorigraph units; the maximum consistency is the mean value of the maximum height of the top of the curve and that of the bottom of the curve.

NOTE — In the relatively infrequent case where two maxima are observed, use the height of the higher maximum.

8.1.1 Use for the calculation the mean value of duplicate determinations of V_c, provided that the difference between them does not exceed 0·5 ml of water.

---

*Methods of sampling for milled cereals and pulses products (*first revision*).

†Methods of analysis for foodgrains : Part 2 Moisture.

TABLE 1 MASS OF FLOUR, IN GRAMS, EQUIVALENT TO 50 AT A MOISTURE CONTENT OF 14 PERCENT (m/m)

(*Clauses* 7.3.1 *and* 8.1.2)

Moisture Content Percent (*m/m*) (1)	Mass of Flour 50 g (2)	Moisture Content Percent (*m/m*) (1)	Mass of Flour 50 g (2)
9·0	47·3	13·6	49·8
9·1	47·3	13·7	49·8
9·2	47·4	13·8	49·9
9·3	47·4	13·9	49·9
9·4	47·5	14·0	50·0
9·5	47·5	14·1	50·1
9·6	47·6	14·2	50·1
9·7	47·6	14·3	50·2
9·8	47·7	14·4	50·2
9·9	47·7	14·5	50·3
10·0	47·8	14·6	50·4
10·1	47·8	14·7	50·4
10·2	47·9	14·8	50·5
10·3	47·9	14·9	50·5
10·4	48·0	15·0	50·6
10·5	48·0	15·1	50·6
10·6	48·1	15·2	50·7
10·7	48·2	15·3	50·8
10·8	48·2	15·4	50·8
10·9	48·3	15·5	50·9
11·0	48·3	15·6	50·9
11·1	48·4	15·7	51·0
11·2	48·4	15·8	51·1
11·3	48·5	15·9	51·1
11·4	48·5	16·0	51·2
11·5	48·6	16·1	51·3
11·6	48·6	16·2	51·3
11·7	48·7	16·3	51·4
11·8	48·8	16·4	51·4
11·9	48·8	16·5	51·5
12·0	48·9	16·6	51·6
12·1	48·9	16·7	51·6
12·2	49·0	16·8	51·7
12·3	49·0	16·9	51·7
12·4	49·1	17·0	51·8
12·5	49·1	17·1	51·9
12·6	49·2	17·2	51·9
12·7	49·3	17·3	52·0
12·8	49·3	17·4	52·1
12·9	49·4	17·5	52·1
13·0	49·4	17·6	52·2
13·1	49·5	17·7	52·2
13·2	49·5	17·8	52·3
13·3	49·6	17·9	52·4
13·4	49·7	18·0	52·4
13·5	49·7		

NOTE — The values in this table were calculated using the formula:

$$m = \frac{4\ 300}{100 - H}$$

where H is the moisture content of the sample, as a percentage by mass.

8.1.2 The valorigraph water absorption, expressed in millilitres per 100 g of flour at 14 percent (*m/m*) moisture content, is equal to

$$(\bar{V}_c + m - 50) \times 2$$

where

$\bar{V}_c$ = mean value of duplicate determinations of the corrected volume, in millilitres, of water corresponding to a maximum consistency of 500 VU; and

m = mass, in grams, listed in Table 1.

Report the result to the nearest 0·1 ml per 100 g.

8.2 Dough Development Time

8.2.1 The dough development time is the time from the beginning of addition of water to the point on the curve immediately before the first signs of decrease of consistency (*see* Fig. 1).

Note — In the relatively infrequent case where two maxima are observed, use the second maximum to measure development time.

8.2.2 Take the mean dough development time from the two curves to the nearest 0·5 min as the result, provided that the difference between them does not exceed 1 min for development times of up to 4 min, or 25 percent of their mean value for longer development times.

8.3 Degree of Softening

8.3.1 Degree of softening is the difference in height between the centre of the curve at the end of the dough development time and the centre of the curve 12 min after this point (*see* Fig. 1).

8.3.2 Take the mean degree of softening from the two curves to the nearest 5 VU as the result, provided that the difference between them does not exceed 20 VU for degrees of softening up to 80 VU, or 25 percent of their mean value for larger values.

8.4 Repetition — If one or more of the differences between measurements on two curves exceed the values specified in **8.1** to **8.3** inclusive, make another two mixings that meet the requirements of **7.4.3**.

9. Precision

9.1 The difference between the values of two determinations on identical test material by one analyst using the same apparatus within a short time interval shall not exceed the repeatability in Table 2.

9.2 The difference between results found by two operators working in different laboratories on identical test material shall not exceed the reproducibility in Table 2.

10. TEST REPORT

10.1 The test report shall show the method used and the results obtained. The report shall also mention any operating details not specified in this standard, or regarded as optional, together with any circumstances that may have influenced the results.

The report shall include all details required for complete identification of the sample.

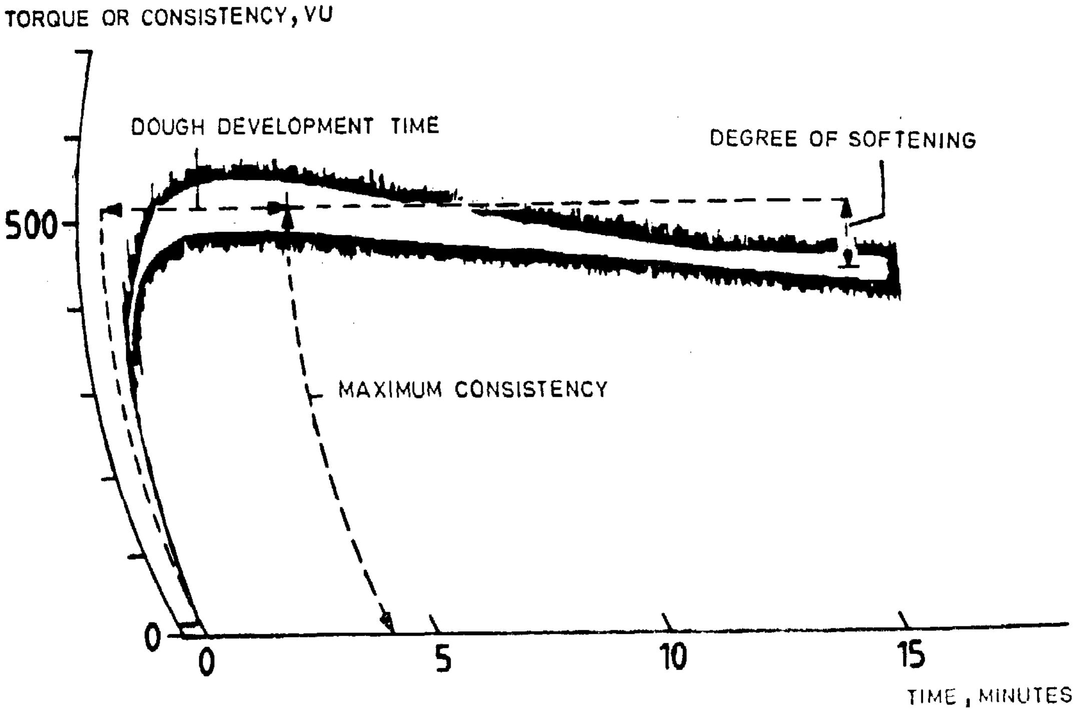


Fig. 1 Representative Valorigram Showing the Commonly Measured Indices

TABLE 2 PRECISION OF VALORIGRAPH MEASUREMENTS

(*Clauses* 9.1 *and* 9.2)

	Repeatability	Reproducibility
Water absorption	0·7 ml per 100 g of flour	5 ml per 100 g of flour
Dough development time	1·0 min	Results inconclusive
Degree of softening	Up to 80 VU : 20 VU Above 80 VU : 25percent of mean value	60 percent of mean value

APPENDIX A

(*Clause* 5.1)

DESCRIPTION OF THE VALORIGRAPH

A-1. GENERAL DESCRIPTION

A-1.1 The valorigraph unit itself consists of a mixer, a means for recording dough consistency in the form of valorigrams and a burette (**A-2**). Its components are illustrated diagrammatically in Fig. 2.

A-1.2 The valorigraph unit is placed in a metal cabinet. The centre part of the cabinet contains the mixer, the burette, and a flask with the stock of water (**4.1**). They are accessible by a plexiglass door in front of the cabinet. The temperature of air in central part of the cabinet is thermostatically controlled (**A-3**).

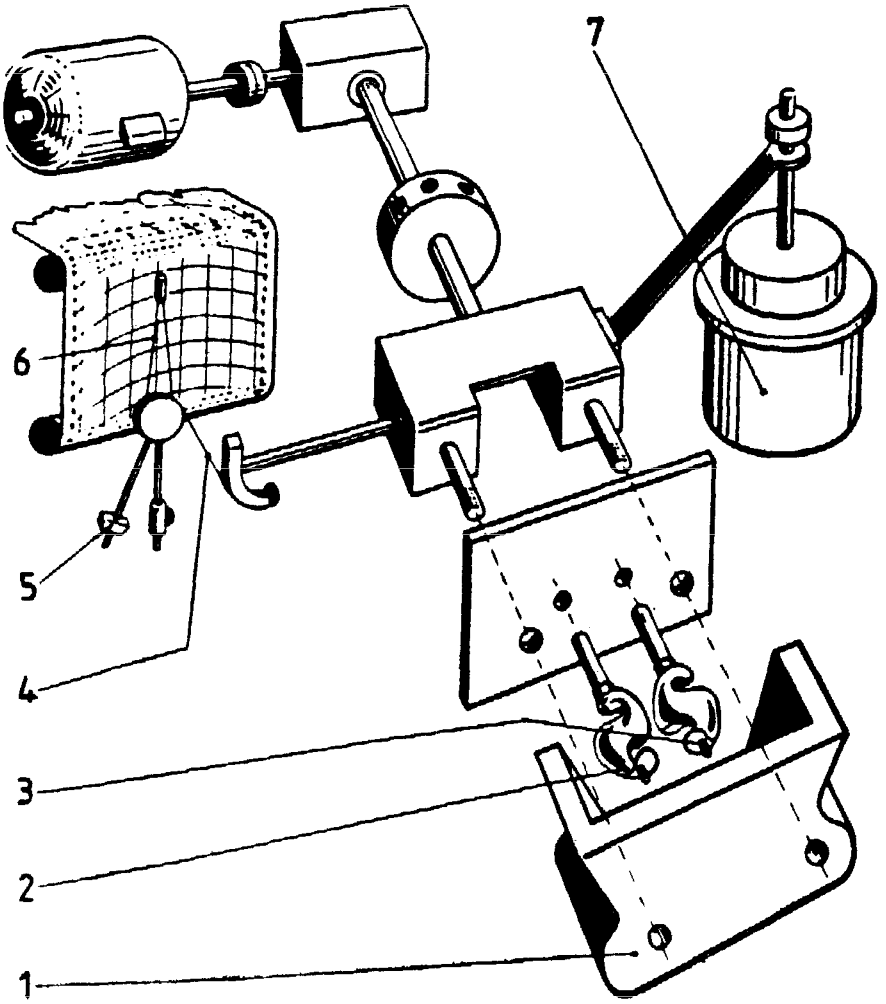
A-2. VALORIGRAPH UNIT

A-2.1 The valorigraph unit consists of:

a) a mixer, the parts of which can be detached (**A-2.2**);

b) an electrical motor, with reduction gear, driving the mixer;

c) a lever system, acting as dynamometer to measure the torque on the mixer (**A-2.3**);



1. Mixer
2. Mixing Blade
3. Pivot
4. Bronze Band Between Arm of Mixer and Lever System of Recorder
5. Lever System of Recorder
6. ARM of Recorder Pen
7. Dash-Pot Damper

FIG. 2 DIAGRAM OF VALORIGRAPH UNIT

d) a dash-pot to damp the movements of the dynamometer (**A-2.3**);

e) a recorder, the pen of which is actuated by the movements of the dynamometer (**A-2.4**); and

f) a burette to measure the volume of water added to the flour.

A-2.2 The mixer is two-bladed and is designed to mix doughs from 50 g of flour. It is made of four parts:

a) the back plate, through which shafts project to attach the mixing blades;

b) two mixing blades; and

c) the remainder of the mixer, that is, two sides, front and bottom in one piece.

A-2.2.1 Parts (a) and (c) are held together by means of two bolts and wing nuts. Parts (b) and (c) inclusive can be removed from the cabinet for cleaning.

A-2.2.2 The slower mixing blade is driven directly by the shaft from the gear; it rotates at a frequency of 64 min^{-1}. The faster mixing blade is geared by cog-wheels to rotate at a frequency which is 1·5 times that of the slower blade.

A-2.2.3 The mixer can be closed by a flat plastic plate, which is laid on top of the mixer. It is removed to add water and to scrape down the dough.

A-2.3 The mixer can pivot on the shaft from the reduction gear. The resistance of dough to being mixed causes a torque on the mixer which, if not balanced, would cause the rotation of the mixer.

A-2.3.1 The mixer carries on its left-hand side an arm, the end of which is connected by the lever system to the recorder pen. This causes a counter-torque on the mixer which is proportional to the deflections of the recorder pen.

A-2.3.2 As a result, the deflection of the recorder pen is, if the two torques balance one another, proportional to the torque on the mixer, that is, to the resistance of the dough to being mixed.

A-2.3.3 The movements of the mixer, lever system, and recorder pen are damped by a piston immersed in silicone oil; the piston is connected to the end of the arm on the right-hand side of the mixer. The extent of damping can be adjusted; more damping results in a narrower curve.

A-2.4 The paper for the recorder is supplied in the form of a roll. It is moved by an electric clock-type motor at a rate of 1·00 cm/min. Along its length, it bears a printed scale in minutes. Across its width, it bears a circular scale (radius 200 mm) with arbitrary units, running from 0 to 1 000 valorigraph units.

A-2.5 The burette is operated by push-buttons, one for filling it, and another for delivering water to the mixer. The choice between two burettes is made on the basis of expected water absorption.

A-3. TEMPERATURE CONTROL

A-3.1 For temperature control, the air in the central part of the cabinet circulates through air ducts containing:

a) an electric preheating element with high power, controlled by a push-button;

b) an electric heating element with low power, controlled by the thermoregulator (c);

c) a thermoregulator in the central part of the cabinet, set at 30°C which controls the heating element (b);

d) a fan, driven by an electric motor; and

e) a metal tubing to cool the instrument by a flow of tap water.

The temperature of oil in the dash-pot damper is maintained at 40°C by an electric heating element and a thermoregulator that controls this heating element.

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 3310131, 3311375

Telegrams: Manaksanstha
(Common to all Offices)

Regional Offices :

	Telephone
Central: Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	3310131, 3311375
*Eastern: 1/14 C.I.T. Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	362499
Northern: SCO 445-446, Sector 35-C, CHANDIGARH 160036	21843, 31641
Southern: C.I.T. Campus, IV Cross Road, MADRAS 600113	412442, 412519, 412916
†Western: Manakalaya, E9 MIDC, Marol, Andheri (East), BOMBAY 400093	6329295

Branch Offices :

'Pushpak' Nurmohamed Shaikh Marg, Khanpur, AHMADABAD 380001	26348, 26349
‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road, BANGALORE 560058	384955, 384956
Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003	66716
Plot No. 82/83, Lewis Road, BHUBANESHWAR 751002	53627
53/3 Ward No. 29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003	33177
5-8-56C L.N. Gupta Marg (Nampally Station Road), HYDERABAD 500001	231083
R14 Yudhister Marg, C Scheme, JAIPUR 302005	63471, 69832
117/418 B Sarvodaya Nagar, KANPUR 208005	216876, 218292
Patliputra Industrial Estate, PATNA 800013	62305
T.C. No. 14/1421, University P.O., Palayam, TRIVANDRUM 695035	62104, 62117

Inspection Offices (With Sale Point):

Pushpanjali, First Floor, 205 A West High Court Road, Shankar Nagar Square, NAGPUR 440010	25171
Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	52435

---

*Sales Office in Calcutta is at 5 Chowringhee Approach, P.O. Princep Street, CALCUTTA 700072	276800
†Sales Office in Bombay is at Novelty Chambers, Grant Road, BOMBAY 400007	896528
‡Sales Office in Bangalore is at Unity Building, Narasimharaja Square, BANGALORE 560002	223971

Printed at Printrade, New Delhi, India